<u>THE UNITED STATES PATENT AND TRADEMARK OFFICE</u>

In re Application of
Kazuhiro Oda et al.
Serial. No. : 10/593,338
Filed: September 19, 2006
For: ALUMINUM ALLOY FOR CASTING, HAVING HIGH RIGIDITY AND LOW LINER EXPANSION COEFFICIENT

Group Art Unit: 1793
Examiner: Roe, Jessee Randall

<u>Declaration Under 37 C.F.R. § 1.132</u>

Honorable Commissioner for Patents
Alexandria, Virginia 22313

Dear Honorable Sir:

I, Kazuhiro Oda, do hereby declare the following:

1. I received my Ph.D. in Material Engineering from Tohoku University in March 1998. Currently, I am employed as a researcher at Nippon Light Metal Company, Ltd., which I joined on April 1998. I am presently engaged in the research and development of aluminum shape casting, which I began on May 6, 1998.

2. I have reviewed the Office Action dated July 31, 2009, in which the claims were rejected under 35 U.S.C.103(a) as being unpatentable over *Nishi et al.* (US 4,919,736), and/or *Horikawa et al.* (JP 2000-204428). In the Office Action, the Examiner asserted that the terms "Poor", "Good", and "Excellent" are used to describe the Young's Modulus and Coefficient of Linear Thermal Expansion of aluminum alloys in the comparative experiments submitted, but the standards for which the Applicant associates "Poor", "Good", and "Excellent" are unclear and not defined. Therefore, I will hereafter present the comparative experimental results between the claimed invention and the inventions of the prior art which were once presented on May 29, 2009, along with the actual values of the Young's modulus and

coefficient of linear thermal expansion, instead of the terms “Poor”, “Good”, and “Excellent”.

3. The major compositions of the aluminum alloys described in each of the claimed inventions, *Nishi et al.* (US 4,919,736), and *Horikawa et al.* (JP 2000-204428) are listed in the below-indicated Table 1.

As shown in Table 1, the nickel content of the aluminum alloy of the present invention is 1-6 mass%. *Nishi et al.* discloses an aluminum alloy containing 0-0.5 mass% nickel. The aluminum alloy compositions do not overlap.

In addition, the aluminum alloy of the present invention does not contain magnesium. *Horikawa et al.* discloses an aluminum alloy containing 0.5-2.0 mass% magnesium. Thus, the aluminum alloy of the present invention is clearly different from that disclosed in *Horikawa et al.*

Table 1

	Major Composition [mass%]							
	Si	Cu	Fe	Mn	P	Ni	Cr	Mg
Claim 5	13-25	2-8	0.5-3	1-3	0.001-0.02	1-6	-	-
Claim 7	13-25	2-8	0.5-3	1-3	0.001-0.02	1-6	-	-
Claim 8	13-25	2-8	0.5-3	1-3	0.001-0.02	0.5-6	0.1-1.0	-
Claim 9	13-25	2-8	0.5-3	1-3	0.001-0.02	0.5-6	0.1-1.0	-
Nishi	13.5-20	6-9	1.6-3	0.5-2	0.001-0.1	0-0.5	-	-
Examples	13.0-15.6	4.04-7.12	0.68-1.88	0.41-1.48	0.05-0.07	0.06-0.08	-	1.16-3.04
Horikawa	11-16	3-7	0.2-1.5	0.2-1.0	0.003-0.015	3-7	0.01-0.3	0.5-2.0
Examples	12.6	4.2	0.51	0.35	0.007	4.5	0.08	1.2

4. The compositions of the aluminum alloys and their measurement results are shown in Table 2, in which the Young’s modulus and coefficient of linear thermal expansion are indicated by their actual quantitative values.

In Table 2, Invention 6-11 represent the aluminum alloys of the present invention. Nishi 1-3 and Horikawa 1-4 represent the aluminum alloys of *Nishi et al.* and *Horikawa et al,* respectively, employed as comparative examples.

The examples of the present invention, Invention 6-8, and the comparative examples of *Nishi et al.,* Nishi 1-3, are the same in the amounts of Si, Cu, Fe, Mn and P in thc aluminum alloys and different in the amount of Ni. In the comparison of Young’s modulus between Invention 6-8 and Nishi 1-3, the values of Invention 6-8 are 91.1 GPa or more, but those of Nishi 1-3 are less than 90.0 GPa.

The example of the present invention, Invention 9, and comparative examples of *Horikawa et al.,* Horikawa 1-4, are the same in the amounts of Si, Cu, Fe, Mn, P and Ni in the aluminum alloys and different in the amount of Mg, *i.e.*, Horikawa 1-4 are aluminum alloys containing 0.6-1.5 mass% Mg and Invention 9 is an aluminum alloy not containing Mg. In the comparison of the coefficient of linear thermal expansion between Invention 9 and Horikawa 1-4, the value for Invention 9 is 17.999 x 10^{-6}/°C, which is less than 18 x 10^{-6}/°C, but those of Horikawa 1-4 are 18.024 x 10^{-6}/°C or more, which is more than 18 x 10^{-6}/°C.

Table 2

	Major Composition [mass%]							Young's Modulus [GPa]	Coefficient of Linear Thermal Expansion [X10^{-6}/C]
	Si	Cu	Fe	Mn	P	Ni	Mg		
Nishi 1	15.2	6	2	1.2	0.01	0	–	89.0	17.784
Nishi 2	15.2	6	2	1.2	0.01	0.3	–	89.6	17.732
Nishi 3	15.2	6	2	1.2	0.01	0.4	–	89.8	17.715
Comparative 4	15.2	6	2	1.2	0.01	0.5	–	90.1	17.698
Comparative 5	15.2	6	2	1.2	0.01	0.6	–	90.3	17.681
Comparative 6	15.2	6	2	1.2	0.01	0.7	–	90.5	17.664
Comparative 7	15.2	6	2	1.2	0.01	0.8	–	90.7	17.647
Comparative 8	15.2	6	2	1.2	0.01	0.9	–	90.9	17.629
Invention 6	15.2	6	2	1.2	0.01	1	–	91.1	17.612
Invention 7	15.2	6	2	1.2	0.01	3	–	95.2	17.269
Invention 8	15.2	6	2	1.2	0.01	6	–	101.3	16.754
Horikawa 1	13	5	1	1	0.01	4	1.5	91.4	18.062
Horikawa 2	13	5	1	1	0.01	4	1.2	91.6	18.050
Horikawa 3	13	5	1	1	0.01	4	0.9	91.7	18.037
Horikawa 4	13	5	1	1	0.01	4	0.6	91.8	18.024
Comparative 1	13	5	1	1	0.01	4	0.3	91.9	18.012
Comparative 2	13	5	1	0.2	0.01	4	0	90.5	18.006
Comparative 3	13	5	1	0.8	0.01	4	0	91.7	18.001
Invention 9	13	5	1	1	0.01	4	0	92.1	17.999
Invention 10	13	5	1	2	0.01	4	0	94.0	17.991
Invention 11	13	5	1	3	0.01	4	0	95.9	17.982

5. As shown in Tables 1 and 2, the aluminum alloy of the present invention differs from the aluminum alloy of *Horikawa et al.*, in that it does not include Mg, and that it includes a specific range of Mn content. Depending largely upon these differences, the alloy according to the present invention was successfully obtained, with the appropriate values for the Young's modulus (e.g., 91.1 GPa or more) and for the coefficient of linear thermal expansion (e.g., less than 18 x 10^{-6}/°C). For example, as understood from Horikawa 1-4 and Comparative Example 1, in cases where Mg is included and the appropriate Young's modulus is achieved, the appropriate coefficient of linear thermal expansion was not achieved. This is probably due to the fact that the Mg-free Si crystallized product of the present invention contributes

more to achieving a low coefficient of linear thermal expansion (and high Young's modulus) than the Mg_2Si crystallized product that is formed by the alloy of *Horikawa et al.* Moreover, even when the Mn content is less than 1 mass% such as 0.2 or 0.8 or the like, as seen in Comparative Examples 2 and 3, an appropriate coefficient of linear thermal expansion still was not obtained.

Accordingly, the present invention obtained by incidentally duplicating the range of the composition of *Horikawa et al.*, eliminating Mg, and specifying a specific range for Mn, *i.e.*, the alloy of the above composition, demonstrates remarkable and/or particular effects of achieving both an appropriate Young's modulus and appropriate coefficient of linear thermal expansion over a claimed range, which is an effect that could not have been anticipated from either of the cited references.

6. In conclusion, I believe that the aluminum alloy with currently claimed range of compositions exhibits unexpected properties over *Nishi et al.* (U.S. Pat. No. 4,919,736) and *Horikawa et al.* (JP 2000-204428), and thus, the present invention is not obvious in view of the cited references.

7. I hereby declare all statements made herein as being true, that all information pertaining thereto is also believed to be true, and that all the abovementioned statements were made with full knowledge that any willfully falsified information, etc. is not only punishable by fines and/or imprisonment, as stipulated under Section 1001 of Title 18 of the United States Code, but may also jeopardize the validity of this application, as well as any patent issuing thereon.

Signature: Kazuhiro Oda

Date: 2009. 10. 2